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WETLANDS/PLAYFIELDS

SPECIAL STUDIES: WETLAND HABITAT CREATION AT THE MISSION BAY PROJECT SITE ON ASSESSOR'S BLOCK #3880, NEAR PIERS 48 AND 50

Prepared for:

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September 1986

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Background and Summary

This Wetlands/Playfields report is one of about 20 special studies for Mission Bay. During the planning process several locations were identified as possible locations for a salt marsh, wetlands habitat. Analysis of those alternative locations both with respect to their ability to serve as wildlife habitat and the desired relationship of wetlands to the new Mission Bay community has led to a preferred location on property east of Third Street near Piers 48-50.

This preferred location is on Port property where present public policy calls for development of a container terminal. Alternative locations are under consideration for such maritime development, and are described in the Container Terminal Options special study. If the Port can achieve its maritime goals elsewhere, as is suggested in that other study, then this Port land inland of Piers 48-50 is a strong candidate for the park use as described in this report.

This report concludes that a viable wetlands habitat could be created on about 13 acres of this site. Buffering at its perimeter could be provided by raised earth berms and landscaping. A fishing area and Bayside view point could be provided at the outermost corner of the site, with pedestrian paths around the perimeter of the wetlands area. Bird habitat islands would be at the center of the wetlands. Sufficient land would be available at the southern end of the parcel for recreational playing fields.

WETLAND SITE ALTERNATIVES

Several sites were examined in Mission Bay as prospective wetland sites. These five sites (see attached Figure 1) were evaluated according to the following criteria:

a) water quality
b) size--area available
c) potential habitat value and diversity
d) accessibility for educational/recreational uses
e) relationship to surrounding uses
f) potential for impacts upon or by the wetlands
g) urban design

Following is a brief summary of the evaluation of each site. A fuller description was provided in Choices for Mission Bay (June 1986).

Site 1: Nearest sewer outflow site; adverse water quality conditions for healthy habitat resulting from about ten (10) storm sewer outfalls/incidents each year; inadequate acreage for configuration options and therefore restricts habitat diversity; shaded by freeway above; very near freeway noise generator; isolation from other development but not very visible or accessible; no conflict with other land uses since this area is not buildable; adverse impact on wetlands if ballpark is located at 7th & Townsend.

Site 2: Relatively good water quality except following storm sewer outflow incidents (approximately ten (10) per year); ample acreage could be provided using acreage north of the channel's current northerly edge; opportunity for fairly diverse habitat but not for species adversely affected by adjacent intensive development; accessible and visible; surrounded by intensive development; wetlands could be adversely impacted by surrounding intensive development and associated activities; and if mudflats form a sizable portion of wetlands, this condition could adversely affect adjacent property values. Since intensive adjacent development and activities will focus on the channel, a more refined urban treatment of the channel area should be provided here rather than a wetlands.

Site 3: Relatively good water quality except following storm sewer outfall incidents (about ten per year); ample acreage could be provided using acreage south of the channel's current southerly edge; opportunity for

fairly diverse habitat but not for species adversely affected by adjacent intensive development; accessible and visible; surrounded by intensive development; wetlands could be adversely impacted by surrounding intensive development and associated activities; and if mudflats form a sizable portion of the wetlands, this condition could adversely affect adjacent property values. Since intensive adjacent development and activities will focus on the channel, a more refined, urban treatment of the channel area should be provided here rather than a wetlands.

Site 4: Relatively good water quality, minimal impact from storm sewer outflow incidents (about ten (10) per year); only about ten (10) available acres, which restricts configuration options and consequently habitat diversity; accessible and highly visible; surrounded by intensive traffic on Third & Fourth Streets and development; wetlands could be adversely impacted by surrounding traffic and development; and if mudflats form a sizable portion of the wetlands, this condition could adversely affect adjacent property values. This site is a gateway or transition site between Mission Bay and developments to the north; it plays a role in the urban landscape and should not be an area returned to nature. It is surrounded by traffic and development and it should therefore be developed as a public space not a wildlife area.

Site 5: Healthy water quality setting; ample acreage from Bay edge to Mission Rock Street for varying configurations and therefore habitat diversity; accessible but the most isolated from development and human activity; least impacted by nearby development and lowest potential for adversely affecting surrounding uses; site cannot be used as wetlands if Port implements container terminal plan for this site and surrounding area.

China Basin Channel is in the middle of a development planned for 10-15,000,000 square feet of new buildings. The land on the Channel's edges will be intensively developed with 6-8-story offices and/or houses and with busy streets. The Channel is expected to serve as a gathering place for groups of all sizes and for events and its edges should accommodate such gatherings. The highly urban nature of the development around the Channel suggests that its development also should have a strong urban character, perhaps with promenades, plazas, bandshells, and somewhat formal landscaped areas. This type of

development on the northern channel edge as well as some softer landscaped areas on the southern channel edge are more appropriate than a wetlands.

Furthermore, the wetlands would be a citywide and regional attraction. It is not appropriate to attract the region's citizens to an area at the heart of the Mission Bay neighborhood. Regional attractions should be on the perimeter of this neighborhood.

Site 1 is an infeasible location to create a viable wetlands; sites 2, 3 and 4 are feasible but not desirable because more urban development should take place in these areas. Site 5 provides the best opportunity for a viable wetlands that can serve as a citywide/regional attraction (a) without attracting visitors into the Mission Bay neighborhood and (b) in a more isolated location for wildlife that will not diminish the potential viability of that habitat.

INTRODUCTION

Based upon analyses and criteria presented in the Wetlands Research Associates (WRA) report, the Philip Williams & Associates (PWA) report and our own investigations of the site and other salt marsh habitats in the Bay Area, the purpose of this working paper is to address the following two questions:

1. CAN A VIABLE WETLANDS HABITAT BE CREATED WITHIN THE 18.25 ACRE SITE KNOWN AS ASSESSOR'S BLOCK #3880 ?

2. IF SO, WHAT IS THE MINIMUM AMOUNT OF SITE SPACE THE HABITAT MIGHT CONSUME, WITH THE NOTION THAT REMAINING PORTIONS MIGHT BE DEVELOPED IN PARK AND ATHLETIC FIELD USES FOR THE MISSION BAY COMMUNITY ?

Further, if feasible, it will describe a general configuration plan for a habitat on the site, including space needs for pedestrianways, associated educational features, buffer zones and adjacent recreational and park facilities.

THE NATURE OF WETLANDS HABITAT DESIGN

It is noteworthy to mention the extreme variability in nearly all the elements involved in the design of a completely natural environment. This is particularly true of a wetlands habitat. Unlike an architectural project which deals with predictable space needs and program elements, precise building materials and controllable relationships, the design elements in a marsh habitat include site materials (fill materials in this case), winds, sedimentation rates, tidal cycles, soil slope stabilities, plant and wildlife patterns, etc., all of which vary with time and season.

The design process must balance these elements against one another in an attempt to give nature a basic physical direction which she will then respond to and change over time. The process must necessarily include a deep understanding of the natural processes involved ----- hydrology, soils characteristics, plant and wildlife needs, food chain relationships and so on. The above factors must finally be manipulated in response to the realities of the precise site and its urban context. Danadjieva & Koenig Associates is appreciative of the excellent contributions by Wetlands Research Associates and Philip Williams & Associates to this preliminary design effort.

STUDY PROCESS

The basic data resources to the study process include the site itself ---- its opportunities and constraints ---- and the natural scientific input on wetlands habitat requirements and hydrology, outlined in the WRA and PWA papers (see appendix).

Two aspects of feasibility were considered, engineering feasibility and biological feasibility. Engineering feasibility, concerned with underlying fill materials, sedimentation rates, grading, etc., was based largely on existing data and, because of budget limitations, remains inconclusive at this point. While more complete investigations will be necessary if and when the project is developed, it was felt that reasonable assumptions would be sufficient for this study. Biological feasibility seemed the more important question at this time because it focused on space requirements and conditions needed to determine whether or not the site was sufficient for the use.

In addition to describing the kinds of wildlife which might be attracted to a habitat at this site, the WRA paper outlines a minimum ideal balance between the various types of habitat spaces ---- dry islands, marsh vegetation, mudflats and open water ---- wildlife use criteria and necessary protection measures. The PWA paper suggests slope, channel width and circulation guidelines as well as techniques for mitigating site development constraints.

The critical space limitation at the site is the 560' available width (between Third Street and the pier area) which appeared insufficient to contain the minimum space requirements. The task was to alter the configuration of the habitat, within the confines of required depths and allowable slopes, so as to offset the losses of space and conditions in the width by expanding in the length, and further, to provide, if possible, recreational uses at the southern end of the site.

The process adopted was one of suggestion and response. D&KA, working with the site width constraint, incorporated the program into a concept plan and identified its resultant shortcomings. Joint work sessions with WRA and PWA would then respond from a functional point of view to resolve the problem issues. The plan was massaged through three generations of "push and pull" until all criteria were met and a feasible habitat configuration was established.

While consideration was given to a full range of design factors including wildlife needs, tidal circulation, plant materials, pedestrian movement and related features, protective measures, buffer zones, views, wind patterns and evolutionary processes, among others, the primary focus of this study was "space." Can a viable wetlands habitat be accommodated on the given site and what is the required amount of space?

Specific design recommendations, other than space needs, are subject for a subsequent design study, however, care has been taken has been taken not to preclude their space requirements in the plan proposed herein.

THE SITE

It is important to note that the findings of this study are not applicable to all sites originally considered for a wetlands habitat at Mission Bay. The proposed criteria as a whole, and they must be considered as a whole, have been set down in response to the characteristics of AB #3880. These are outlined in the WRA paper.

Assessor's Block #3880 is approximately 560 ft. wide and 1280 ft. long. Altogether it is 18.25 acres, including a 1.2 acre space which protrudes toward San Francisco Bay at the northeast corner of the site. The effective design width, for the habitat, is the 560 ft. dimension between Third Street and the eastern edge of the property, adjacent to the pier area.

Site opportunities include its proximity to San Francisco Bay and the open waters at the mouth of China Basin, the space available and its relative isolation from human activity. Isolation is still a major concern, however, and buffering of noise and visual motion from Third Street and pier activity must be taken into account if an abundant bird community is to be encouraged. While a 100 ft. buffer zone is recommended, site constraints permit no more than 50 feet. Earth berming and heavy tree planting must be incorporated as a mitigating measure. Perhaps the greater problem exists at the southern edge, if athletic fields are to be developed. A wider zone with larger berms and denser tree masses will be necessary there.

ADAPTING DESIGN CRITERIA TO THE SITE

The WRA paper suggests a minimal radius (assuming a circle with a protected island space in the center) of 430 ft. The full diameter of 860 ft. is obviously larger than the available site width of 560 ft. so the first task was to see if allowable slopes, required channel depths/widths and minimal public buffer zones were even possible within the 560 ft. site width. Figure A illustrates that they can be accommodated, but only by significant reductions in the proposed widths for islands, marsh vegetation areas, mudflats and open water.

To resolve these problems, mitigative design measures include the following:

1. Overall design configurations were elongated, allowing gentler slopes at the ends to counter maximum slopes at the width.

2. Island configurations were adapted with berms and protected areas to make up for lack of width.

3. A vertical retaining structure was proposed along the western edge of the habitat. This enabled a greater area of open water with minimal loss of public buffer zone. The wall is also placed to reflect incoming wave energy to encourage the maintenance of open water over time while providing pedestrian access immediately adjacent to the open water edge. Outer mudflats and marsh vegetation areas (less useful to the birds) were eliminated in this area.

4. Two kinds of islands were proposed ----- a shallow, vegetated island for shorebirds, herons and egrets and a higher, rocky island for gulls, terns, cormorants and pelicans. The islands were placed to allow the winter southeasterly winds to promote wave action between them.

5. In order to achieve an undulating natural edge configuration within the parameters of allowable soil slopes, areas of rock rip-rap were proposed along the sides.

6. The mouth of the habitat was proposed to be 250 ft. wide at elevation +3 MSL. This will enable wave action at the mouth to prevent the encroachment of marsh vegetation,

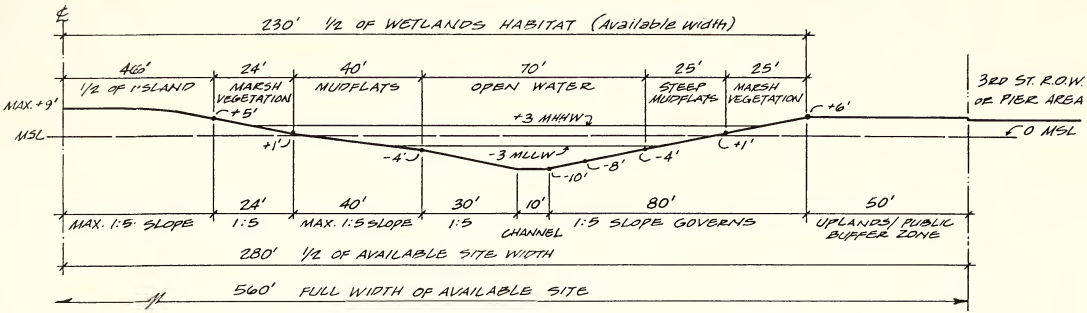

℄
230' 1/2 OF WETLANDS HABITAT (Available width)
46'
1/2 OF ISLAND
24'
MARSH VEGETATION
40'
MUDFLATS
70'
OPEN WATER
25'
STEEP MUDFLATS
25'
MARSH VEGETATION
3RD ST. R.O.W. OR PIER AREA
MAX. +9'
+5'
+3 MHHW
+6'
MSL
0 MSL
+1'
-4'
-3 MLLW
-10'
-8'
-4'
+1'
24'
MAX. 1:5 SLOPE
40'
1:5
MAX. 1:5 SLOPE
30'
1:5
10'
CHANNEL
80'
1:5 SLOPE GOVERNS
50'
UPLANDS/ PUBLIC BUFFER ZONE
280' 1/2 OF AVAILABLE SITE WIDTH
560' FULL WIDTH OF AVAILABLE SITE
0
20'
40'
60'
80'

FIGURE A

thereby preserving a portion of desireable intertidal mudflats.

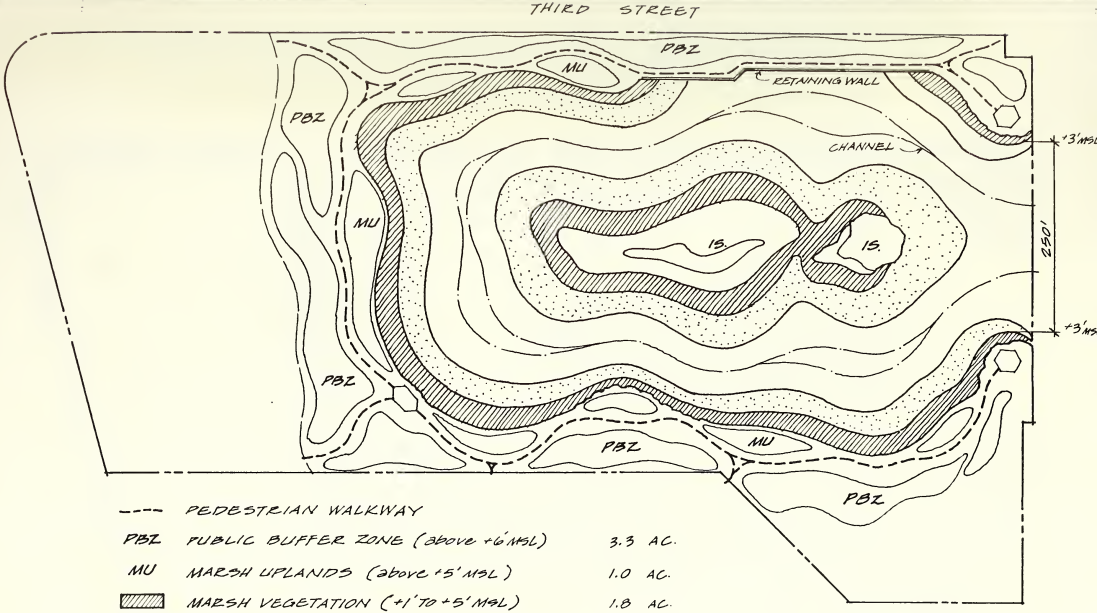
7. Channel widths are greater where space permits, in order to maximize the areas of open water.

8. Pedestrianways meander around the marsh, closer in areas of open water and generally set back along the areas of mudflats and marsh vegetation where greater distances between birds and people/pets are necessary.

9. Berms in the uplands and public buffer zone areas are maximized to provide the greatest amount of habitat protection within the narrowest amount of site space.

10. Because of the confined area of the habitat, human/pet encroachment must be restricted. It is advisable to provide barriers along the pedestrianways.

Utilizing the above, a viable wetlands habitat plan was developed which provides a reasonable balance among areas required for islands, marsh vegetation, mudflats, open water,marsh uplands and public buffer zone. The thirteen (13) acre plan represents the minimal amount of space needed for a healthy wildlife sanctuary and associated public amenities at the proposed site. Figure B indicates the basic plan configuration by area/acreage.



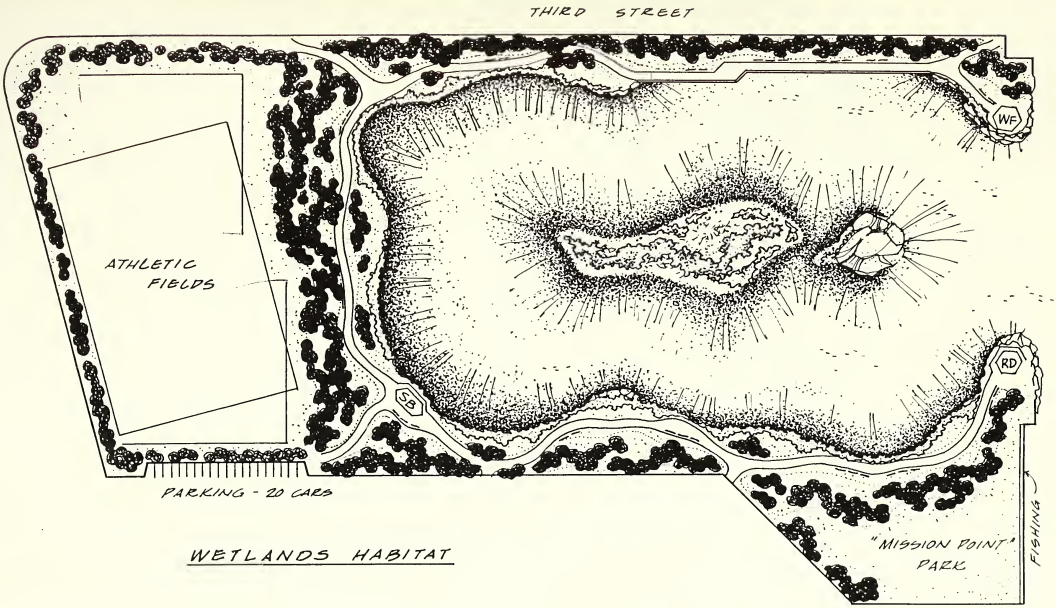
----	PEDESTRIAN WALKWAY	
PBZ	PUBLIC BUFFER ZONE (above +6' MSL)	3.3 AC.
MU	MARSH UPLANDS (above +5' MSL)	1.0 AC.
	MARSH VEGETATION (+1' TO +5' MSL)	1.8 AC.
	INTERTIDAL MUDFLATS (-4' TO +1' MSL)	2.3 AC.
	OPEN WATER (below -4' MSL)	3.9 AC.
IS.	ISLAND HABITATS (above +5' MSL)	0.7 AC.
	TOTAL	13.0 AC.

FIGURE B

ILLUSTRATIVE SITE PLAN

Figure C offers an illustrative view of the habitat plan as well as a possible arrangement of athletic fields and parking for 20 cars at the southern end of the site. The protruding 1.2 acre space at the northeastern corner of the site is proposed as a park ---- "Mission Point" ---- providing space for picnics, free play, sitting and walking and offering dramatic views over the Bay. An important recommendation for Mission Point is the provision for fishing along the China Basin edge. This is largely aimed at discouraging fishing within the wetlands habitat.

Dense planting around the habitat (and the athletic fields) will be required for buffering and will frame the entire parcel up to China Basin. Plantings will be salt tolerant species and/or placed in berm areas to provide planting depth above ground water. Seating can be incorporated at viewing areas along the pedestrian walk as can educational display features at appropriate locations to describe waterfowl (WF), shorebirds (SB), rock dwellers (RD) and perhaps some history of Mission Bay.



WETLANDS HABITAT

FIGURE C

SUMMARY

1. The findings of this study, based on the information gathered, are that it appears reasonable that a viable wetlands habitat can be developed on AB #3880.

2. The minimum space required for the habitat, including all uplands and buffer zones, is thirteen (13) acres, provided that berming and tree planting around it is maximized and that human/pet intrusion is restricted to the established pedestrianways. More space would provide a better habitat. Less space would be insufficient for adequate wildlife protection.

3. The remaining land on AB #3880 is sufficient to support athletic fields (two softball diamonds and a soccer/ footbal field are indicated) and parking for about 20 cars, assuming that access is possible. There is also a 1.2 acre park site proposed at the northeast corner of the parcel.

With sensitive planning and design, the wetlands habitat will constitute a valuable educational and recreational amenity for the Mission Bay project and the City of San Francisco.

WETLANDS RESEARCH ASSOCIATES, INC.

SPECIAL STUDIES: WETLAND HABITAT CREATION AT MISSION BAY PROJECT SITE BETWEEN PIERS 48 AND 50

Prepared for:

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PURPOSE OF REPORT

The report, "Choices for Mission Bay: Planning Considerations" outlined a number of alternatives for wetland habitat creation within the Mission Bay project area. Of the five locations discussed, the most favorable location in terms of the potential for high wildlife use is at the mouth of the channel adjacent to Pier 48 and 50. The main advantages for wildlife at this location are its proximity to the bay, greater potential for full tidal flushing, flexibility in size and shape of the wetland, and greater isolation from human activity. From the planning perspective, a wetland located within this area provides a natural gradation from the urban landscape to the open water of the bay, creates an important passive recreational area for the local inhabitants, and reduces the conflicts between public and wildlife needs which can occur when wetlands and urban areas are adjacent to one another. Finally, the restoration of wetlands at this site will serve as a historical reminder of Mission Bay's past function as part of the bay system.

A special study was initiated by the City Planning Department to examine the feasibility of re-creating wetland habitat on the portion of the project site adjacent to Piers 48 and 50. The purpose of this report is to discuss the biological issues which must be addressed: what types of wetland habitat/open space could be created on the site; the size of the wetland area; and compatibility of public access, recreation, and wildlife uses. The report is not intended to exclude consideration of other areas within the Mission Bay Project area for wetland habitat creation nor does it consider any mitigation issues which might arise following an EIR/EIS. The major

objective of this plan is to provide for fish and wetland bird resources along the eastern shoreline of San Francisco while providing passive recreational uses. This report is the sixth in a series prepared by Wetlands Research Associates, Inc. on the wetland habitat needs and requirements within the Mission Bay Project site.

Due to time and budget constraints, a full analysis of the fish and wildlife needs in the region could not be completed. The region is highly urbanized and little information is currently available on habitat types and wildlife utilization. A limited field observation period was available during a period of the year (August) when migratory wildlife use is minimal. Much of the information or conclusions reached in this report are based on data developed for other areas of the bay or based on the experience of Wetlands Research Associates, Inc. personnel with wetland habitat evaluation. The report is based on a number of assumptions:

1. The fill material at this site can be feasibly excavated and disposed on or off-site;
2. the fill material remaining following excavation will be suitable for wetland plant growth;
3. existing activities within the Port will remain at the same level;
4. wildlife usage on various habitat types, ie. rocky shore, vegetated marsh, open water, will be similar for the restored area as natural areas of the same size in less urbanized areas of the bay; and
5. the area will be managed with the primary goal of preserving and encouraging wetland natural resources and a secondary goal of providing recreational and educational uses.

GENERAL DESIGN CONSIDERATIONS

Many functions have been attributed to wetlands: groundwater recharge, flood protection, nutrient retention/removal, wildlife habitat, passive recreation and aesthetic uses, and shore stabilization among others. Wetlands may perform one, many, or all of these functions. The primary objective of the habitat creation at the Mission Bay site is the provision of wildlife habitat, particularly fish and waterbirds. This objective is not exclusive of other wetland functions especially those associated with public access. In fact, the creation of a valuable wildlife habitat should enhance the public use of the area for passive recreation, education, and open space. To accomplish this objective, several restrictions on adjacent activities must be placed on the overall design of the site:

1. Reduce or eliminate urban pollutant runoff into the wetland area;
2. maintain full tidal flushing of the system;
3. create sufficient buffers between wetland and public use areas to maximize wildlife use;
4. reduce or eliminate physical (eg. roadway noise, building heights) and visual (eg. auto traffic, pedestrians) barriers to wildlife movement between China Basin Channel, the bay, and the new wetland habitat; and
5. develop designs which reduce impacts from predators associated with the urban environment, ie. cats, dogs, and rats.

In addition to the restrictions which must be placed on the surrounding development, the proximity of the urban environment also places requirements

on the wetland design:

1. Eliminate areas where odor problems could develop;
2. reduce areas where wind-blown or dumped trash might accumulate;
3. restrict habitat creation to common species in the area and do not attempt to create habitat for rare or endangered species;
4. consider species for site which are tolerant of close human proximity;
5. plan areas which provide public access to the site; and
6. incorporate public safety considerations including fencing, shallow slopes, and handicap access.

These set of restrictions or constraints will be considered within the design of the wetland habitat. At present, they do not appear to be mutually exclusive. The feasibility of creating a wetland habitat at this location is high with the understanding that the site will not be the exclusive domain of either wildlife or urban dwellers.

CURRENT WILDLIFE USES ADJACENT TO THE SITE

The area proposed for wetland creation currently lacks any wildlife use. It is paved and developed as a storage area. It also contains several tank areas for oil storage. Although there is some use by fish and birds in the channel and open bay waters along the northeast corner of the site, this use is minimal at present.

As part of this report, a brief field reconnaissance of the eastern shoreline of San Francisco was made to determine the existing wildlife

habitat in the region. The study focused primarily on bird habitat and utilization. It is important to remember, however, that fish and invertebrates also use the shoreline as a nursery area for breeding and growth of juveniles some of which serve as food items for birds. The field work identified several habitats along the shoreline which are currently used by wildlife: rocky intertidal areas, mudflats (some with submerged vegetation), and open water. Vegetated marshes were notably absent along the shoreline. The areas of significant wildlife habitat are shown in Figure 1 and a summary of the habitats and the birds observed is given in Table 1.

Table 1: Identification of wetland habitat and wildlife within the Mission Bay Project and adjacent areas. Numbers (n) listed under habitat type correspond to location of areas illustrated on Figure 1.

PIER NO.	LOCATION	HABITAT TYPE	BIRD USE
2	Ferry bldg.	Piers, cement headwalls	Gulls
46	Channel St.	Monterey Pines, Monterey Cypress, 265 ft. of exposed mudflat (1), 950 ft. of shoreline edge vegetated with *Salicornia virginica* (2), 730 ft. of rip-rap (3), 450 ft. of steep bank (4)	Gulls, herons, egrets, shorebirds
48	China Basin	Piers, Mission Rock, 400 ft. of rip-rap	Gulls
70	Todd Shipyard	Piers, 150 ft. of rip-rap	Gulls

Table 1: Identification of wetland habitat and wildlife within the Mission Bay Project and adjacent areas. Numbers (n) listed under habitat type correspond to location of areas illustrated on Figure 1.

72	23 rd Street	Exposed sandy/ gravel shoreline of 350 feet (5), gas tanks and eelgrass (Zostera) bed approximately 1 acre (6)	Gulls
80	24 th Street	600 feet of exposed sandy/ gravel shoreline (7)	Gulls, shorebirds
	Islais Creek	Piers, 930 feet of exposed shoreline with patches of pickleweed (Salicornia virginica) and gumplant (Grindelia humilis); approximately 1 acre of undeveloped upland area of fennel (Foeniculum vulgar) (9)	Gulls, shorebirds (8)
94		Small shoreline approximately 100 feet vegetated with pickle-weed, gumplant and baccharis (Baccharis pilularis) (10)	Gulls, shorebirds, terns
	Avisadero Point	Piers, rip-rap, 1/4 mile of levee inter-spersed some pickle-weed and fennel (11)	Gulls, terns, shorebirds, cormorants
	Hunter's Point	Piers, rip-rap	Gulls, terns, cormorants
	Double Rock Cove	1 large and 1 small rock (13), rip-rap, sandy beach approxi-mately 300 feet (12); mudflat exposed during low tide	Gulls, terns, cormorants, shorebirds, pelicans, scoters

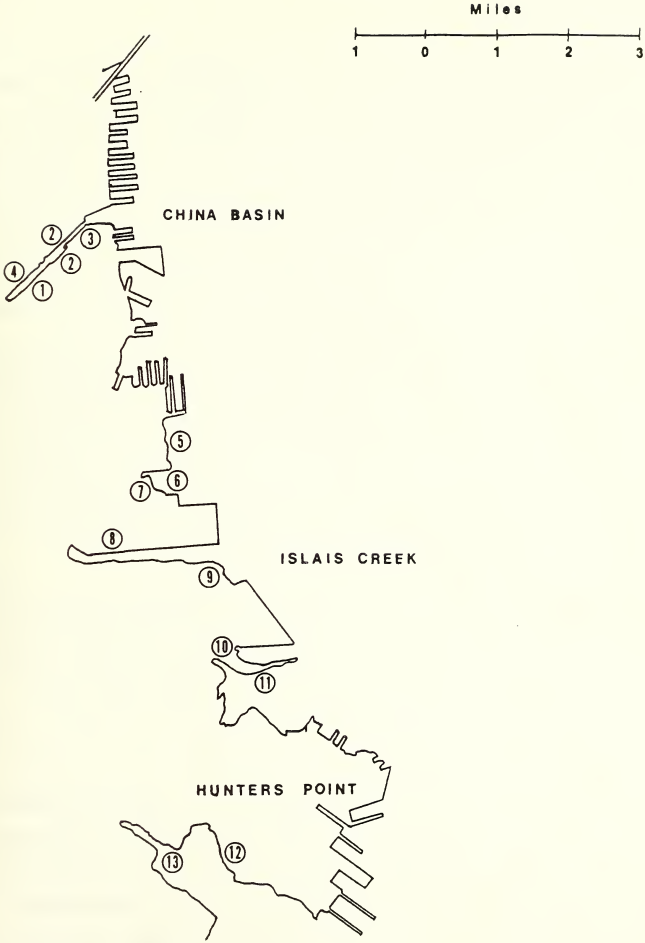

Figure 1. Location of habitat types identified along the eastern shoreline of San Francisco between China Basin and Double Rock Cove. Numbers refer to habitat types listed in Table 1.

In addition to the areas observed along the eastern shoreline of San Francisco, there are a number of significant shallow water wildlife habitats on the eastern shoreline of the San Francisco Bay, including the Emeryville Crescent, Crown Memorial Beach and Refuge in Alameda, and San Leandro Bay. The distances to these habitats is approximately 15 to 20 miles and it is feasible for birds to travel these distances for feeding and roosting.

The results of the field reconnaissance indicate that most of the birds utilizing the eastern shoreline of the City and County of San Francisco are associated with either open water or mudflat habitat (Table 2). The majority of these birds are migratory, that is, they are primarily within the bay area during the spring and fall. The low diversity of species observed during August should not be used as an indicator of the potential use of the restored habitat as greater diversity and abundance can be expected during the peak of the migration. The habitat requirements for the migratory species are primarily feeding and resting areas.

However, a number of species observed adjacent to the site are resident birds, that is, they breed and raise young in the bay area, primarily during the spring and summer months. These birds have specific habitat requirements as listed below:

Black-crowned Night Heron

Black-crowned Night Herons spend the day in dense tree canopies of marshes vegetated with cattails or tules. They feed on fish, crustaceans and large insects. Most feeding activity is restricted primarily to nocturnal hours. Colonies still persist in some urban areas and a large colony of over 400 pairs is located in a semi-marsh shrubby island in the City of San Francis-

co. This species is a colonial nester constructing their nests in trees, shrubs and sometimes on the ground.

American Avocet

The nest is a hollow on an open flat, dike or near the edge of the marsh. When nesting in marshes they may nest in *Distichlis* areas or on the bare ground near the edge of *Spartina* or *Salicornia*. Bare ground on islands is also an attractive nesting site for this species.

Black-necked Stilt

The nest of this species is similar to the American Avocet. This species is commonly found nesting on dikes around the San Francisco Bay area, particularly around salt evaporation ponds. When nesting in marsh areas, the nest consists of more vegetation materials. The bare ground of islands is also a good nesting site for this species.

Killdeer

The nest of this species is a hollow with little or no lining scraped out of the ground. The nest is commonly excavated in gravel areas or in barren ground. Upland areas above marshes with dry, barren areas is another attractive nesting site for this species. This species will also nest on dikes or barren portions of islands.

Double-crested Cormorant

The nest of this species is constructed in trees or on cliffs or rocky islands. When nesting in trees Double-crested Cormorants build a platform nest of sticks usually located in the spreading branches of trees. On islands or coastal colonies the platform is constructed on wider ledges,

shoulders and usually, in higher sites.

Western Gull

This species usually nests on the tops of islands or rocky headlands with gentle slopes. They will also nest on ledges of cliffs and occasionally on bridges, boats or dock side roofs. The nest is a low mound or depression lined with grass or seaweed. The Farallon Islands off San Francisco supports one of the largest breeding colonies of this species.

Based on the information collected above, a summary of the bird habitats required on the site is given in Table 2.

Table 2. Habitat types required by birds expected to occur within the restored wetland habitat in the Mission Bay Project.

SPECIES TYPE	SPECIES	HABITAT TYPE
Shorebirds	Western Sandpiper Least Sandpiper Long-billed Dowitcher Willet American Avocet Black-necked Stilt Black-bellied Plover Dunlin Marbled Godwit Killdeer	Mudflat, some use of marsh vegetation such as saltgrass (Distichlis spicata) as roosting site during high tide
	Ruddy Turnstone Wandering Tattler	Rocky intertidal
Herons, Egrets	Great Egret Great-blue Heron Snowy Egret Black-crowned Night Heron	Marsh channels, marsh vegetation: saltgrass (Distichlis spicata) and cordgrass (Spartina foliosa) used as high tide roosting site; Night herons roost in tall trees, cattails, and tules

Table 2. Habitat types required by birds expected to occur within the restored wetland habitat in the Mission Bay Project.

Gulls	Western Gull Heerman's Gull Ring-billed Gull	Open water, mudflat
Terns	Forster's Tern	Open water, mudflat
Waterfowl	Greater Scaup Lesser Scaup Surf Scoter Ruddy Ducks Canvasbacks	Open water
Grebes	Western Grebe Eared Grebe	Open water
Cormorants	Double-crested Cormorant	Open water
Pelicans	Brown Pelican	open water

Although fish and invertebrate habitats were not sampled in this study, one can reasonably expect high diversity and abundance of fish in shallow bay habitats. Such areas are extremely important due to the historical loss of shallow estuarine habitats in San Francisco Bay, and especially along the City's shoreline. Fish utilize a variety of habitats: shallow ponds, sloughs, and narrow marsh channels. Mobile crustaceans such as shrimp and crabs as well as mudflat dwelling species primarily use shallow water areas adjacent to marshes. Therefore, it is likely that except for high marsh and island areas, a variety of fish and invertebrates species will benefit from the increase in habitat created at this site.

DESIGN CRITERIA FOR WETLAND HABITAT AT THE MISSION BAY PROJECT SITE

The design criteria for the Mission Bay wetland habitat is considered in three components: types of habitats to be created on the site, size of habitat, and public access.

Types of habitat

The primary habitat to be created is tidal shallow water. The majority of the birds expected in this region utilize open water/mudflat areas. During high tide, the majority of the site should be submerged to provide areas for waterfowl, gulls, terns, grebes, cormorants, and pelicans. During low tide, a portion of the site should be exposed to provide mudflat areas to attract and support shorebirds. However, at no time should the site be completely exposed.

Generally, the elevations suitable for tidally exposed mudflats range between -4 to +1 feet MSL. Because mudflats will be the primary feeding area for birds, they should be in areas furthest from the human activity. Mudflat areas should receive full tidal action each day to eliminate any odor problems which can develop if water stagnation occurs. However, tidal currents should be minimized where mudflats are desired as the currents will cause erosion.

The open water areas will occur where depths are below -4 feet MSL. Generally, depths should not exceed -10 feet MSL. Consideration should be given to the effect of sedimentation in the open water areas. If sedimentation rates are high, greater excavation may be necessary to accommodate the decrease in depth due to sediment accumulation. In the long-term, it may be necessary to dredge portions of the site to maintain open water depths. As

an partial alternative, the site should be designed to maximize tidal and wind scouring in areas to be maintained as open water.

Because there is a potential for a number of birds to nest in the area, an island(s) should be created on the site. Two types of islands are suggested: a smaller, rocky outcropping for cormorants, pelicans, and gulls and a larger, vegetated island for night herons and shorebirds. The islands need not be separated, however, they will differ substantially in their appearance and utilization.

The rocky island (actually may be constructed of concrete or gunite) should be at least 0.1 acre in size and rise up to 12 to 15 feet above MSL. It should be constructed to appear similar to other habitats utilized by these species in San Francisco Bay, ie. Red Rock, The Brothers, The Sisters. Although there may be crevices for some vegetation to grow, the majority of the island will be rocky with some protection for young birds provided by small windbreaks of rock or concrete.

The vegetated island should be approximately 0.5 to 0.6 acres in size for that portion rising above +5.0 feet above MSL. The island, itself, should not exceed more than +9.0 feet above MSL. The island will be vegetated with native plants such as coyote brush and gum plant. Several poles for roosting may be placed near the edge of the island, but they should generally not exceed the height of the vegetation (about 4 to 5 feet). The island should be constructed of a bay mud base material and a sandy silt surface. If available, broken shells or gravel should be placed on the top barren surface of the island to provide nesting materials for shorebirds.

Additionally, the top portion of the island should be round to flat. This shape will provide a surface attractive to nesting shorebirds. The island should provide protected areas from the wind, especially winter southeasterlies.

A small salt marsh will surround the islands and wherever elevations range between +1 to +5 feet above MSL. Slopes should be planned such that most of the marsh plants develop around the islands to provide feeding and resting areas for herons and egrets. The egrets may utilize the vegetated island for nesting.

In summary, the majority (greater than 50%) of the site should be planned as shallow open water. Of the remainder, approximately 15-30 % should be mudflat, 10-15 % saltmarsh, and 10-15 % island.

Size of habitat

Habitat size can be estimated in two ways: determination of habitat requirements of species desired or establishment of distances between wildlife areas and public access. While the first is the most direct method, it is difficult to apply for a wide variety of birds due to lack of information about individual species. More is known about the distances which should be employed as buffers between wildlife and public access, although these criteria have also lacked rigorous scientific testing.

Because the area under consideration in this report is adjacent to the open bay, absolute sizes based on species requirements do not have to be met entirely within the site. Except for some of the shorebirds and the night herons which nest locally, most of the birds and fish expected for this site

can migrate great distances for food and nesting areas. The primary use of this site will be to supplement existing resources and to provide a roosting area during high tides and storms. Therefore the best way to determine habitat size is to estimate the distances which should exist between the more sensitive areas and the surrounding public uses. Sensitive areas are defined as habitats which support critical life requirements for wildlife, eg. feeding, breeding, as compared to less sensitive habitats which provide roosting or simply, open space. For the wetland habitats being considered for the Mission Bay site, the relative "sensitivities" of habitat are as follows:

Greatest sensitivity----------Lowest sensitivity
Nesting island > Mudflats > Vegetated marsh > Rocky intertidal > Open water

Thus, the greatest distances should be provided between public uses and areas for nesting (island) and feeding (mudflat). Smaller distances and direct public access can be provided adjacent to the rocky intertidal and open water.

To reduce public use impacts on the nesting areas, the distance should be at least 250 ft. Most birds can sense intruders at shorter distances and would be unlikely to utilize areas for nesting or breeding if constantly disturbed. Birds feeding on mudflats can also be easily disturbed, however, as long as the area is relatively open (so that they can quickly fly away if the intruder or predator approaches too closely), they can tolerate closer distances by humans. It is suggested that the distance between public areas and mudflat areas range between 150 to 200 ft. Vegetated marsh areas provide cover within the plant canopy. As a result the distances between marsh

vegetation and public access can be relatively close, on the order of 100 ft. The rocky intertidal and the open water areas support primarily fish and invertebrates which are generally not disturbed by adjacent human uses (except for pollution) and so these habitats types do not require buffers. However, to maximize waterfowl use of these areas, some upland buffer should be provided. Generally a 100 ft buffer between the edge of the wetland and high use upland areas is suggested by wildlife agencies. The use of heavy vegetation planting, berms, or fences can reduce this distance if less sensitive species occur in the wetland.

The discussion above suggests that the habitat should be designed as primarily open water with an island in the middle providing nesting habitat. The island should also be surrounded by mudflat where possible. Approaching the design as a simple circle, the radius of the circle is 430 ft (80 ft radius island (for 0.5 acre island) + 250 ft distance from island to edge of pond + 100 ft upland buffer). This results in an area of wetland habitat plus buffer of approximately 13.5 acres.

The design itself can exhibit greater flexibility than the formula applied above. Certain mitigating features such as berms, noise barriers, etc can be used to reduce impacts of human activity on the wildlife. In addition, the site should be designed for variety as both the wildlife species and the human users will also vary in their use of the open space.

Public access

Wetland and estuarine habitats are desirable for both wildlife and humans. It is likely that this site will be utilized for a number of

purposes: passive recreation such as bird watching, walking, and jogging; active recreation such as fishing and organized games; and environmental education. In order to protect the values that most people will gain from this habitat creation the following criteria should be considered:

1. No boat use should occur on the site. The tidal entrance should have a floating barrier to keep boats out.
2. No bridges or walkways should be built out over the site.
3. Public access should be provided at well defined locations with bench seating, fencing, and interpretative signs.
4. Fencing should be used to define public pathways adjacent to the marsh/open water areas. Lease laws should be enforced.
5. Open water should be wide enough to discourage "bridge building" by children and crossing by feral pets.
6. Fishing areas should be provided along the channel edge and bay-front so that fishing is discouraged within the wetland area.
7. Vegetation and berms should be utilized between the active recreational areas and the wetland to prevent balls from entering the marsh area.
8. Pathways should be designed to meander around the site such that they are furthest from the edge in areas with mudflats and saltmarsh and may be closer in areas of rocky intertidal and open water.

In considering the requirements for public access adjacent to the wetland area, some thought should be given to the evolution of the site from the initial conditions. Sedimentation will occur in protected areas furthest from tidal action. This will result in the formation of mudflats and

vegetated marsh that have a greater sensitivity than open water. Therefore, public access should be set back.

SUMMARY

It seems reasonable, based on the information collected, to provide habitat for wetland plants and animals within the Mission Bay Project site defined in this report. Approximately 13.5 acres of habitat (including buffers) should be suitable. Shallow open water with some intertidal areas are the primary types of habitat to create. Another key element is the creation of islands: a rocky island for gulls, cormorants, and pelicans, and a low vegetated island for shorebirds. With appropriate planning, this open space element will be a valuable addition to the project and the City of San Francisco.

SPECIAL STUDIES: WETLAND HABITAT CREATION

AT MISSION BAY PROJECT SITE,

AB #3880, NEAR PIERS 48 AND 50

Hydrologic Analysis

Prepared for:

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HYDROLOGIC ANALYSIS

1. Site Characteristics

The proposed site is completely formed out of man-made fill and varies in elevation from approximately +4 to +9 ft. NGVD (-4.6 to +0.4 S.F. City Datum). The fill was placed sometime between 1878 and 1892, and the site apparently was first used as a lumber yard.

In 1853, water depths in this area were apparently approximately 12 to 18 ft. below MLLW (-15 to -21 ft. NGVD). Elsewhere in Mission Bay, the placement of fill has compressed the underlying mud by about 10 ft. Consequently, it is likely that there is a thickness of at least 30 ft. of fill on site.

The composition of this fill is uncertain and could contain building debris, rock garbage, and sand. Borings will have to be carried out to determine the nature of the fill material and whether toxic pollutants are present.

2. Sedimentation

The rate of sedimentation is a key design parameter in marsh restoration that dictates how rapidly the mudflats and marshes will evolve to a "natural" form. Suspended sediment is brought in on each tide and settles out at slack water. Part of this is resuspended during the ebb flow or by wave action.

For this site, it is likely that the sedimentation rates will be similar to those experienced in Mission Creek above Fourth St., provided the main flow channel is close to the Third St. bridge. Surveys have been made in the area in 1964, 1968, 1976, 1981, and 1984. According to a longtime resident of Mission Creek, the channel was dredged to -12 ft. MLLW in 1968 for freeway construction.

Based on this survey information, it appears that siltation rates of approximately 1/2 ft. per year are typical for deeper water (at about -10 ft. MLLW). As the water shallows, the siltation rate decreases to about 1/4 ft. per year at about MLLW.

This means that if the site is excavated to allow tidal action to take place, sedimentation will occur that within a few years will blanket most of the old fill material, provided large pieces of debris have been removed. This sediment will provide a suitable substrate for marsh vegetation and benthic organisms.

3. Grading Requirements

The main channels should be excavated to at least -8 ft. NGVD to allow adequate tidal drainage at low tide. These channels should also be excavated with a minimum bottom width of 10 ft.

The dredging tolerance varies with the type of material to be removed. To ensure that target depths are achieved, overdredging of at least 1/2 ft. should be carried out in the

channels. If large pieces of building rubble are present, up to 2 ft. of overdredging may be required in the channels.

The maximum safe slope grading requirements depend on the characteristics of the fill material. It is unlikely that the underlying Bay mud will be encountered in the excavation. For the purposes of this preliminary design, a maximum slope of 5:1 can be used.

Any fill placed as an island should allow for the approximately 2 ft. of settlement predicted for this area. Therefore, to ensure that an island remains above the present 1-year high tide level, it should be filled to at least +9 ft. NGVD.

4. Evolution of the Marsh

Sedimentation will cause the marsh to evolve over a period of several decades from predominantly open water and intertidal mudflats to predominantly salt marsh drained by meandering slough channels. This process would be most rapid where wave action is weakest at the southern end of the site and slowest where wave action is most intense close to the mouth.

If it is desired to preserve a portion of the site as intertidal mudflat, advantage can be taken of the wave action at the mouth to prevent the encroachment of marsh vegetation. This can be done by providing a wide opening to the Mission Creek channel, approximately 250 ft. This may also cause some erosion

of the northern shore of any island placed in the marsh and should be anticipated in the design.

Mud flats can also be preserved if vertical walls border the site. These reflect wave energy and can slow the encroachment of marsh vegetation.

5. Circulation and Water Quality

Because of the large tidal exchange in the marsh, it is not anticipated that circulation or water quality will be a problem except for possibly the infrequent occasions when large discharges of wastewater occur into Mission Creek. Over time, the channels will silt up and from narrow winding slough channels; however, tidal exchange will continue to be large.

The most significant waste problem may be the deposition of floating debris, algae, and trash as a wrack line around the perimeter of the marsh during high tides. However, this can easily be removed periodically if it proves to be a nuisance.